Offprint from "Marine Biology"
International Journal on Life in Oceans and Coastal Waters, Vol. 22, No. 1, October 1973, Pages 75—76

First Report on the Triggering Effect of Light on the Hatching Mechanism of *Artemia salina* Dry Cysts

P. Sorgeloos

Laboratorium voor Biologisch Onderzoek van Milieuverontreiniging, State University of Ghent; Ghent, Belgium

Marine Biology 22, 75—76 (1973)

First Report on the Triggering Effect of Light on the Hatching Mechanism of *Artemia salina* Dry Cysts

P. Sorgeloos

Laboratorium voor Biologisch Onderzoek van Milieuverontreiniging, State University of Ghent; Ghent, Belgium

Abstract

In the literature, hatching of *Artemia salina* L. dry cysts has always been related exclusively to the hydration state of the cysts. Hatching experiments with cysts from different places revealed that light in some way triggers the hatching mechanism.

Introduction

Resting or diapause stages of many arthropods are known to resume active development when exposed to one or more exogenous stimuli (Andrewartha, 1952; Lees, 1955). For example Pancella and Stross (1963) found that ephippial eggs of *Daphnia pulex* are stimulated to hatch when exposed to fluorescent light. These authors however, did not determine the very moment at which the light stimulus triggers the hatching process.

Although much fundamental research has been devoted to the brine shrimp *Artemia salina* L. (Littlepage and McGinley, 1965; Nimura, 1967), little or no attention has been paid to the influence of light on the developmental biology of this crustacean.

During hatching experiments with dry cysts of *Artemia salina* from saline lakes in Utah, USA (Sorgeloos, 1971), we observed several times that light influences the hatching process: hatching efficiency is considerably higher under conditions of continuous light than in darkness.

Experiments on this interesting phenomenon were performed during a sojourn at the Duke University Marine Laboratory (Beaufort, N.C., USA). The present paper deals with the results of this first study.

Materials and Methods

A small quantity of dry cysts of *Artemia salina* (commercial cysts from Bulgaria and USA: Utah and California) were hydrated in complete darkness in natural sea water of 35‰ S.

With a micropipette, series of 100 eggs each were then transferred one by one from the bottom of the hydration tube to small petri dishes containing 5 ml sea water. These transfers were performed in a dark room under low and indirect illumination (bulb of a dissection microscope).

The petri dishes were then incubated for 60 h at 28 °C; one set of 5 petri dishes (A) being kept in complete darkness, two others (B and C) being illuminated for 1 h at the start of the experiment: the former with a fluorescent tube at an irradiance of 8.5 W/cm², the latter with a normal light bulb at 195 W/cm². After the 1 h illumination, Sets B and C were transferred to complete darkness.

Table 1. *Artemia salina. Percent hatching (± standard deviation) of 3 stocks of cysts in continuous darkness (A) and in light (B and C)*

Stock	Dark (A)	Light	
		8.5 W/cm² (B)	195 W/cm² (C)
Bulgaria	26 ± 2	40 ± 3	40 ± 2
Utah	48 ± 3	73 ± 3	73 ± 4
California	62 ± 1	95 ± 2	95 ± 1

Results

The hatching results are summarized in Table 1, from which it appears firstly, that the differences between the dark and the light series are statistically significant at the 95% confidence level. Secondly, there is absolutely no difference in hatching percentage between the two illuminated sets.

Further experiments revealed that some of the cysts, hydrated in complete darkness, nevertheless hatched. The others, which had not hatched even after 60 to 120 h incubation in sterile sea water in complete darkness, started to hatch 24 to 48 h after being exposed to light.

Discussion

In the extensive literature on hatching of *Artemia salina* dry cysts, the hatching trigger has always been

exclusively related to the hydration state of the cysts. These new results clearly demonstrate that the embryological development in the cysts, when hydrated, is related to some triggering light stimulus.

The trigger mechanism has a very low threshold: variation of irradiance intensity from 8.5 to 195 W/cm^2, with dominances either in the blue part (fluorescent tube) or the red part (normal bulb) of the spectrum had no statistically significant influence on hatching efficiency. On the other hand, the embryological development of hydrated embryos that are not stimulated by light, can be delayed until the light trigger is applied.

The fact however, that a small percentage of the cysts nevertheless hatch in complete darkness, seems to demonstrate that cysts can, in some way, respond to an anteriorly received light stimulus and hatch immediately after hydration.

Experiments are in progress to induce adult *Artemia salina* to oviparity in complete darkness and to collect and dry the cysts in darkness. With the latter, it should then be possible to detect the critical light wavelength, intensity, time of exposure, etc.

Summary

1. In the literature on hatching of *Artemia salina* L. dry cysts, the trigger has always been related exclusively to the hydration state of the cysts.

2. Hatching experiments with cysts from Bulgaria and USA: Utah and California revealed that light influences the hatching process: hatching efficiency is considerably higher in light than in darkness.

3. Light stimulates hatching at a very low irradiance intensity.

4. Part of the cysts respond to an anteriorly received light stimulus and hatch immediately after hydration in complete darkness.

5. The embryological development of hydrated embryos that are not stimulated by light can be delayed until the light trigger is applied.

Acknowledgements. I wish to thank Professor Dr. J. Costlow, Director, for the facilities provided at the Duke University Marine Laboratory, Beaufort (N.C., USA) during my summer sojourn in 1972, and Professor Dr. G. Persoone for continuous interest in this work. These investigations were supported by a grant of the Belgian Ministry of National Education and of the Belgian National Foundation for Scientific Research (N.F.W.O.).

Literature Cited

Andrewartha, H. G.: Diapause in relation to the ecology in insects. Biol. Rev. **27**, 50—107 (1952).

Lees, A. D.: The physiology of diapause in arthropods, 135 pp. London: Cambridge University Press 1955.

Littlepage, J. L. and M. N. McGinley: A bibliography of the genus *Artemia* (*Artemia salina*) 1812—1962, 73 pp. San Francisco: San Francisco Aquarium Soc., Inc. 1965.

Nimura, Y.: Biology of the brine shrimp. Bull. Jap. Soc. scient. Fish. **33**, 690—702 (1967).

Pancella, J. R. and R. G. Stross: Light induced hatching of *Daphnia* resting eggs. Chesapeake Sci. **4**, 135—140 (1963).

Sorgeloos, P.: De kweekproblematiek van invertebraten: experimenten met *Artemia salina* L., 183 pp. Thesis, Gent. 1971 (Unpublished).

Author's address: P. Sorgeloos
Laboratorium voor Biologisch Onderzoek
van Milieuverontreiniging
State University of Ghent
Plateaustraat 22
B-9000 Ghent
Belgium

Date of final manuscript acceptance: July 3, 1973. Communicated by J. W. de Blok, Texel